STUDIES ON TRAVEL TIME RELIABILITY FOR INTERCITY EXPRESSWAY UNDER VARIOUS EVENTS

Takeshi Mastsushita

Traffic Division Maintenance and Operation Department,

West Nippon Expressway Company Ltd.

Dojima Avanza 19F, 1-6-20 Dojima, Kita-ku, Osaka, 530-0003, Japan

t.matsushita.ab@w-nexco.co.jp

ABSTRACT

NEXCO-West, one of the intercity toll road operators in Japan, provides travel time information on its expressways. Currently, travel time information is provided in limited areas, and those information has less priority in case of traffic accident. travel time. Moreover, many signboards only provide information on congestion length, during the congestion caused by traffic accidents.

As a result, many customers complain about lack of travel time information in case of traffic jams and traffic accidents, since they spend more time than they have expected.

Using the traffic speed data measured by vehicle sensors near the major traffic congestion points, this paper describes results of analysis on distribution of travel time during various events occurred in the past year. The paper also reviews travel time an indicator called Buffer Time (*BT*), and suggests more comprehensive travel time indices to drivers compared to *BT*.

KEY WORDS

BT, travel time reliability

1. INTRODUCTION:

West Nippon Expressway Company (hereafter “NEXCO-West”) is operating and managing expressways over 3,300km in length in the western part of Japan.
Approximately 2.3 million traffics are on its expressways every day. (Apr-2009)
We are providing real-time traffic information by various means such as Variable Message Signboard (hereafter “VMS”) at highway entrance and exit, , toll gates, or JCTs, and radio broadcasting. Furthermore, we are providing the same information by use of cellular phone using internet function.
It is true that real-time information is informative and helpful for driver’s who are about to leave their home or office, but these data cannot be useful for driver’s decision making on their travel plan for his future trip (i.e., tomorrow or maybe next week).
We are providing information of congestion forecast, and estimated travel time to destination IC for 5 months by use of the record of past 3 years at areas in heavy inbound traffic congestion.
Therefore, these data are not useful once the incidents occurred.
Especially, people who need to catch international flight must be very punctual, and travel time reliability is very important. However, so far the travel time information has not been enough to meet their demand.
In this paper, results of analyses concerning travel time reliability is described, by calculating the required time for any departure time with or without incident.
Some case studies were performed using sample sections of 30km to 100km interval including the areas with frequent traffic congestion.

2. METHOD OF ANALYSIS

2.1 Target of analysis

For our case-study, 5 sections shown in Table 1 was used as sample cases. They were selected based on their frequent occurrence of traffic congestion between 2008-Jan-1 to 2008-Dec-31 (365days).
In this paper, results of case studies for section #3 and #4 is described.

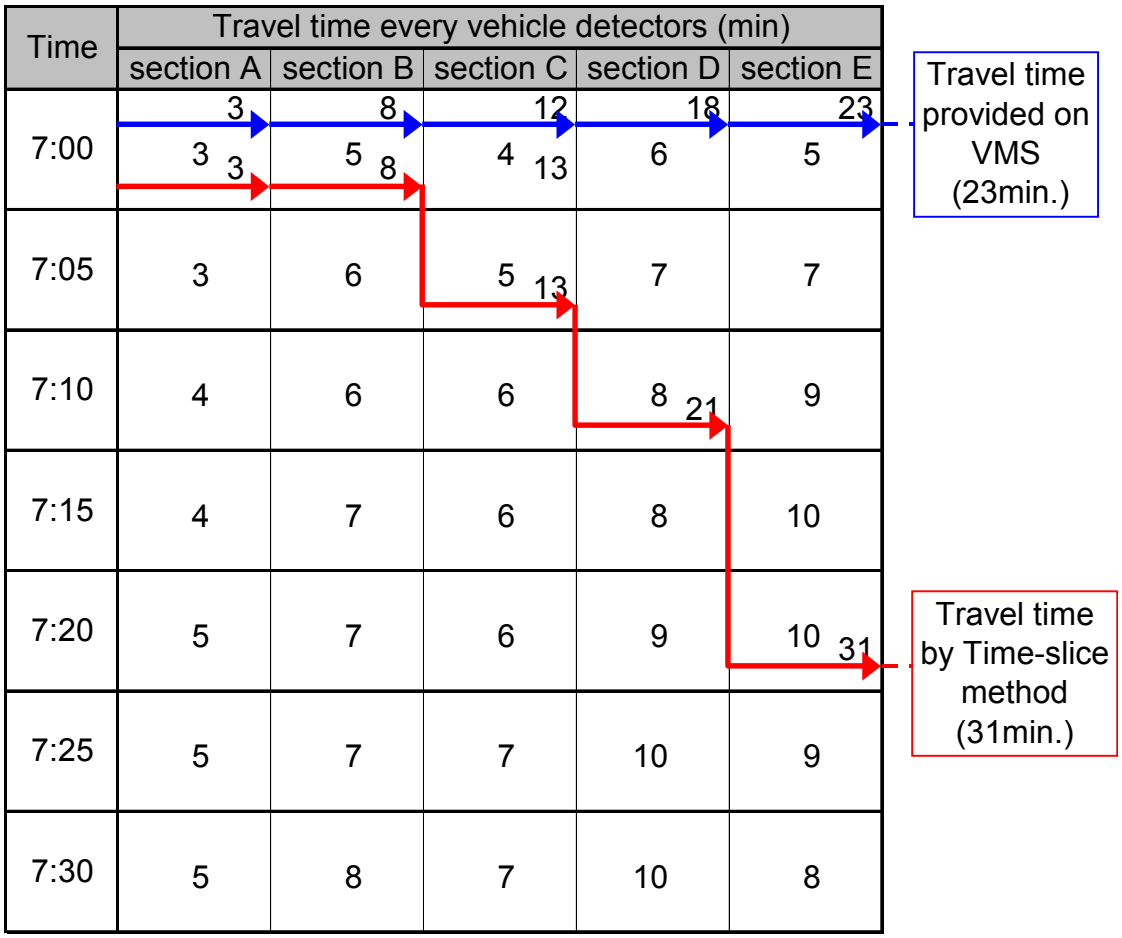
Table 1 Target of analysis

№	Road Name	Section			Length	Congestion Number of Times (2007)
1	Meishin-EXPWY	Suita	～	Nishinomiya	21.3 km	174
2	Kinki-EXPWY	Suita	～	Matsubara	27.5 km	1551
3	Chugoku-EXPWY	Chugoku-Suita	～	Nishinomiya-kita	28.9 km	769
4	Hanwa-EXPWY	Matsubara	～	Gobo	101.9 km	660
5	Nishimeihan-EXPWY	Matsubara	～	Tenri	27.2 km	465

2.2 Calculating travel time by time-slice method

Time-slice method a is a dynamic travel time estimation method to calculate travel time by considering elapsed time from departure and dynamically summing up each travel time.
The velocity data were provided from vehicle detectors located every 2km interval.
In this paper, departure time was set every 5 minutes, requiring 12 samples within 1 hour.
Travel time provided on VMS is the estimation at the time of departure.

Fig. 1 Conception of Time-slice method



2.3 The classification of travel time

We analyzed the decrease of travel time reliability at the time of incidents (i.e., traffic accidents or road work) by classifying calculated travel time with or without incident using the past record of congestion data.

3. TRAVEL TIME RELIABILITY ANALYSIS BY THE DAY

We calculated a reliability index by the days of the week with a normal time reliability index without the incident to analyze the change of the travel time reliability by the difference of the day.

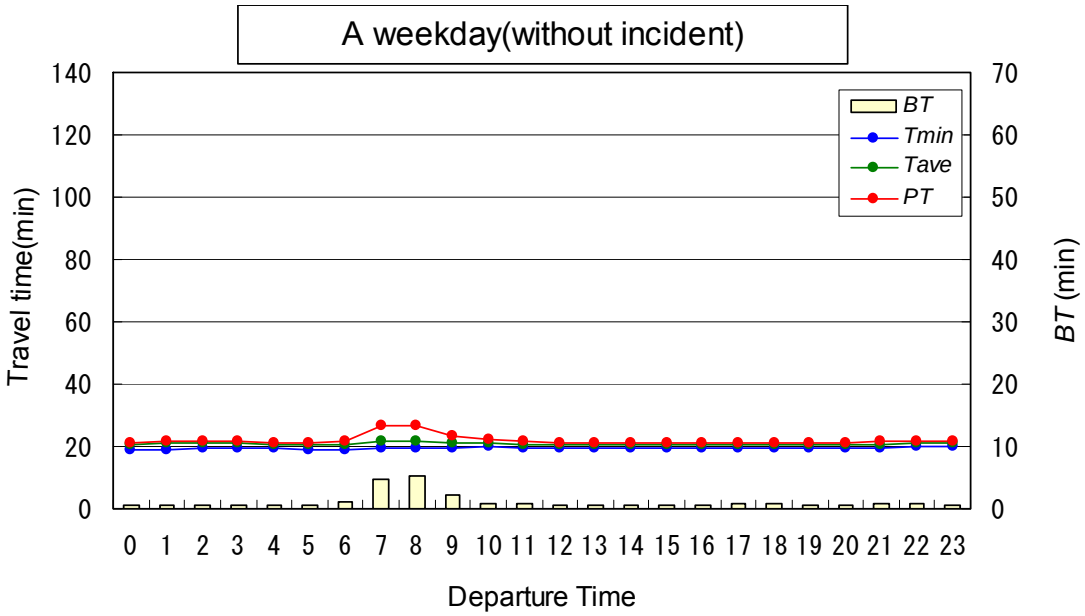
3.1 Section #3 Chugoku Expressway Chugoku-Suita – Nishinomiya-kita (30km)

This section is experiencing frequent congestion in almost whole section on weekend and seasonal traffic congestion period.

3.1.1 A weekday

Travel time is increased from 7:00 am to 9:00 am, and the peak point is shown around 8:00 am.
Around the peak period, Average travel time (*Tave*) is 21 minutes (2 more minutes compared to the 5%-tile travel time (*Tmin*) of 19minutes).
95%-tile travel time (Planning Time hereafter *PT*) was about 27 minutes (8 minutes increase from *Tmin*)
Buffer time (*BT*) was 5 minutes.
The change of the travel time is small except above mentioned time, and the difference of *Tmin* and *PT* is less than 3 minutes for each time. *BT* for each hour is almost limited within one minute, (See Fig-2)

Fig. 2 Travel time (a weekday) without incident



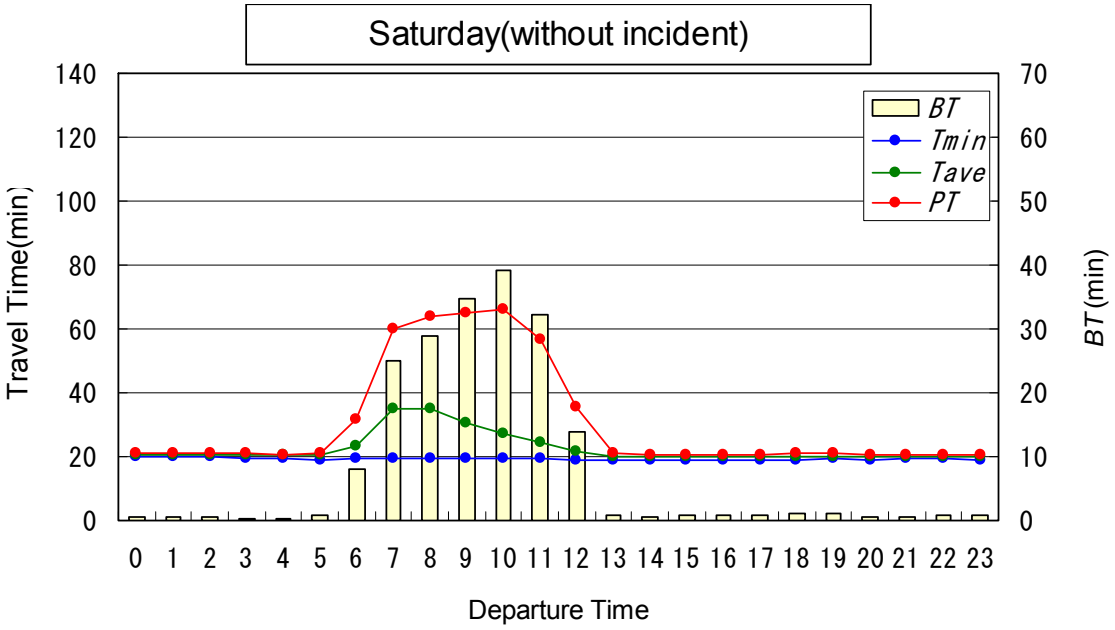
3.1.2 Saturday

Travel time is increased from 6:00 am to 12:00 am, and the peak point is shown around 10:00 am.

Around the peak period, Average travel time (*Tave*) is 27 minutes (7 more minutes compared to the 5%-tile travel time (*Tmin*) of 20minutes). *PT* was about 66 minutes (46 minutes increase from *Tmin*). Buffer time (*BT*) was 39 minutes.

The change of the travel time is small except above mentioned time, and the difference of *Tmin* and *PT* is less than 2 minutes for each time. *BT* for each hour is almost limited within one minute, (See Fig-3)

Fig. 3 Travel time (Saturday) without incident



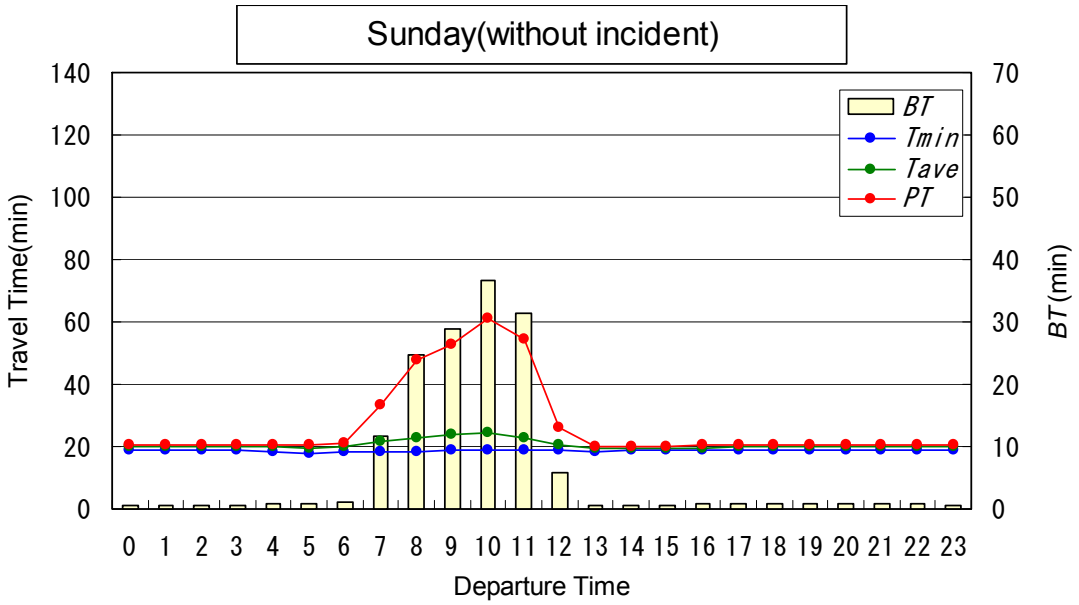
3.1.3 Sunday / Holiday

Travel time is increased from 7:00 am to 12:00 am, and the peak point is shown around 10:00 am.

Around the peak period, Average travel time (*Tave*) is 24 minutes (5 more minutes compared to the 5%-tile travel time (*Tmin*) of 19minutes). *PT* was about 61 minutes (42 minutes increase from *Tmin*). Buffer time (*BT*) was 37 minutes.

The change of the travel time is small except above mentioned time, and the difference of *Tmin* and *PT* is less than 3 minutes for each time. *BT* for each hour is almost limited within one minute, (See Fig-4)

Fig. 4 Travel time (Sunday / Horiday) without incident



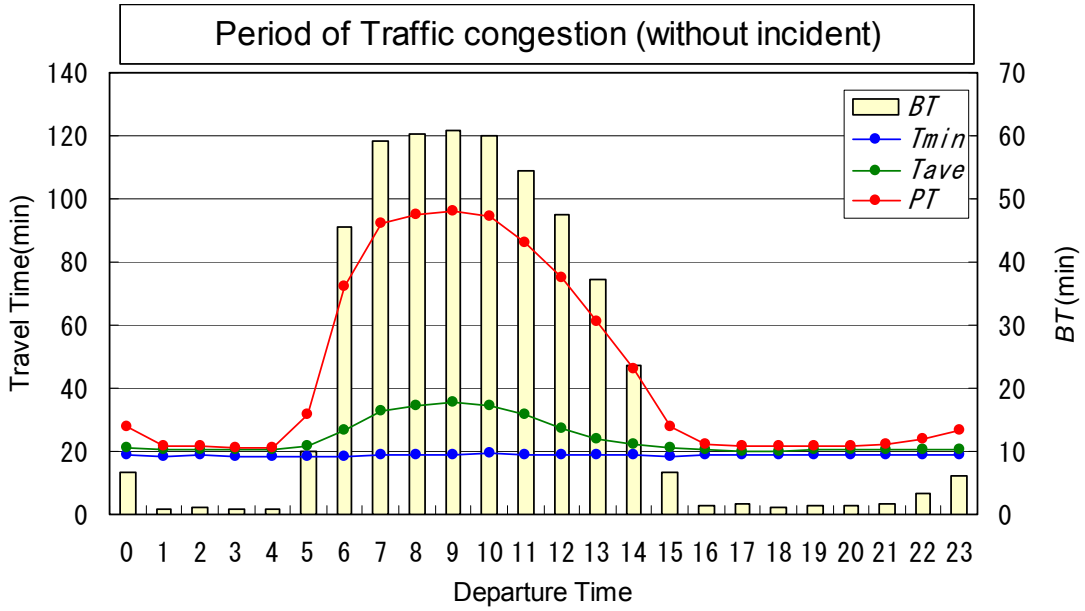
3.1.4 Period of Traffic congestion

Travel time is increased from 5:00 am to 3:00 pm, and the peak point is shown around 9:00 am.

Around the peak period, Average travel time (*Tave*) is 35 minutes (16 more minutes compared to the 5%-tile travel time (*Tmin*) of 19minutes). *PT* was about 96 minutes (77 minutes increase from *Tmin*). Buffer time (*BT*) was 61 minutes.

The change of the travel time is small except above mentioned time, and the difference of *Tmin* and *PT* is less than 3 minutes for each time. *BT* for each hour is almost limited within 2 minutes, (See Fig-5)

Fig. 5 Travel time (Period of Traffic congestion) without incident



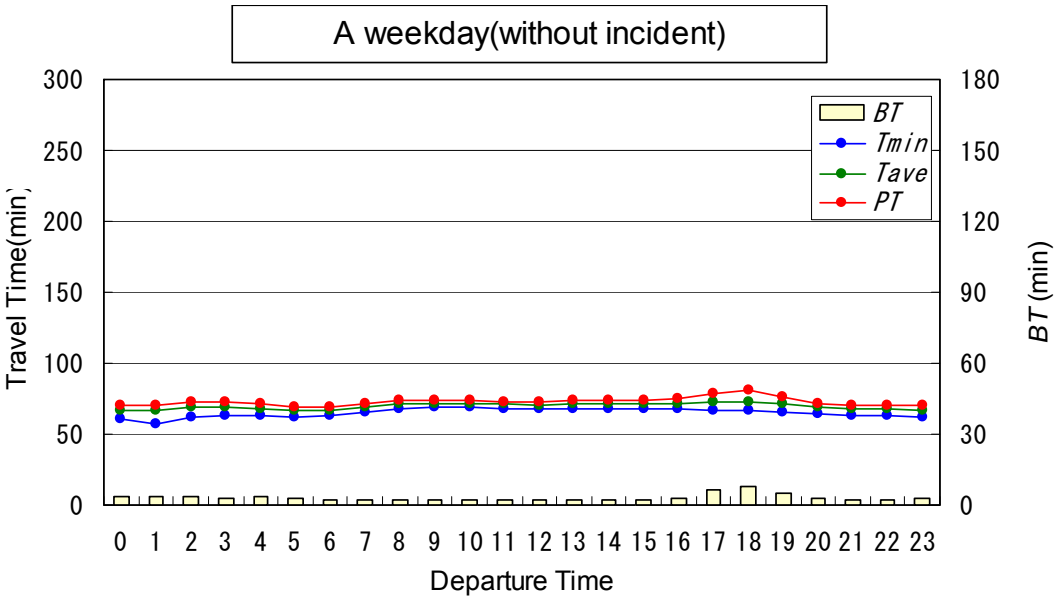
3.2 Section #4 Hanwa Expressway Gobo – Matsubara (100km)

This section is experiencing frequent congestion about 20 km on weekend and seasonal traffic congestion period.

3.2.1 A weekday

In comparison with other days, a change is small for weekday travel time. (See Fig-6)

Fig. 6 Travel time (A weekday) without incident



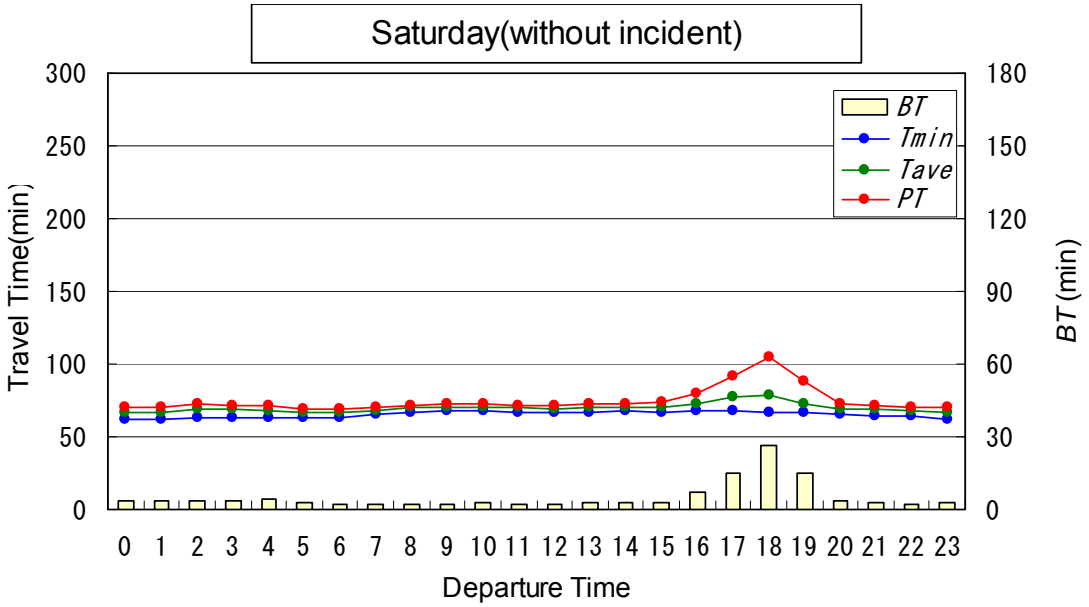
3.2.2 Saturday

Travel time is increased from 4:00 pm to 7:00 pm, and the peak point is shown around 6:00 pm.

Around the peak period, Average travel time (*Tave*) is 78 minutes (11 more minutes compared to the 5%-tile travel time (*Tmin*) of 67minutes). *PT* was about 105 minutes (38 minutes increase from *Tmin*). Buffer time (*BT*) was 27 minutes.

The change of the travel time is small except above mentioned time, and the difference of *Tmin* and *PT* is less than 7 minutes for each time. *BT* for each hour is almost limited within 3 minutes, (See Fig-7)

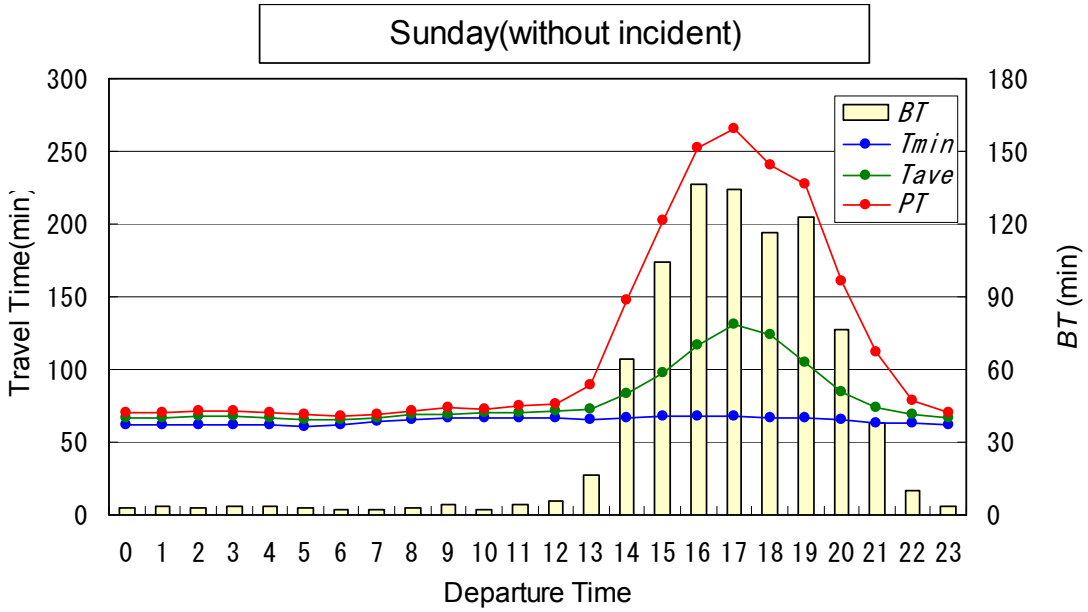
Fig. 7 Travel time (Saturday) without incident



3.2.3 Sunday / Holiday

Travel time is increased from 12:00 am to 10:00 pm, and the peak point is shown around 5:00 pm.
Around the peak period, Average travel time (*Tave*) is 131 minutes (64 more minutes compared to the 5%-tile travel time (*Tmin*) of 67minutes). *PT* was about 265 minutes (198 minutes increase from *Tmin*). Buffer time (*BT*) was 134 minutes.
The change of the travel time is small except above mentioned time, and the difference of *Tmin* and *PT* is less than 8 minutes for each time. *BT* for each hour is almost limited within 5 minutes, (See Fig-8)

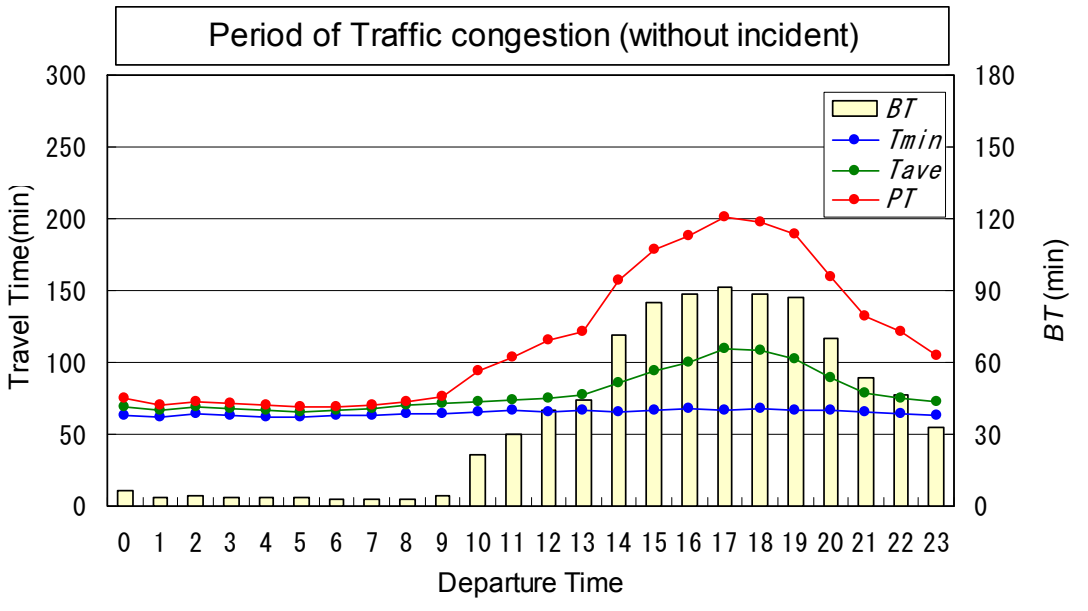
Fig. 8 Travel time (Sunday / Horiday) without incident



3.2.4 Period of Traffic congestion

Travel time is increased from 9:00 am to 1:00 am, and the peak point is shown around 5:00 pm.
Around the peak period, Average travel time (*Tave*) is 110 minutes (43 more minutes compared to the 5%-tile travel time (*Tmin*) of 67minutes). *PT* was about 201 minutes (134 minutes increase from *Tmin*). Buffer time (*BT*) was 92 minutes.
The change of the travel time is small except above mentioned time, and the difference of *Tmin* and *PT* is less than 9 minutes for each time. *BT* for each hour is almost limited within 4 minutes, (See Fig-9)

Fig. 9 Travel time (Period of Traffic congestion) without incident



4. TRAVEL TIME RELIABILITY ACCORDING TO THE INCIDENT PRESENCE

In order to figure out the deteriorating condition of travel time reliability with incidents, we compared Planning Time (*PT*) at normal time (without incident) and the case with incident. (See Table-2)
In addition, 2 sections above mentioned, we compared travel time reliability according to incident presence. (See Fig-10,11)

Table 2. Travel Time reliability according to the incident presence

№	Road Name	Section	Length	A Day	Departure Time	*PT* (min)		
						Normal (A)	Incident (B)	(B)-(A)
1	Meishin-EXPWY	Suita ～ Nishinomiya	21.3 km	Period of Traffic congestion	11:00am	25.9	87.1	61.2
				Weekday	9:00am	15.7	64.2	48.5
2	Kinki-EXPWY	Suita ～ Matsubara	27.5 km	Saturday	8:00am	26.9	119.2	92.3
				Period of Traffic congestion	8:00am	31.3	145.8	114.5
3	Chugoku-EXPWY	Chugoku-Suita ～ Nishinomiya-kita	28.9 km	Weekday	4:00pm	22.7	118.3	95.6
				Period of Traffic congestion	1:00pm	60.9	110.0	49.1
4	Hanwa-EXPWY	Matsubara ～ Gobo	102 km	Sunday/Horiday	5:00pm	265.2	381.5	116.3
				Saturday	8:00am	98.9	326.6	227.7
5	Nishimeihan-EXPWY	Matsubara ～ Tenri	27.2 km	Weekday	6:00pm	20.7	132.7	112.1
				Weekday	8:00am	19.9	128.9	109.0

Fig. 10 Travel time (Period of Traffic congestion) without incident

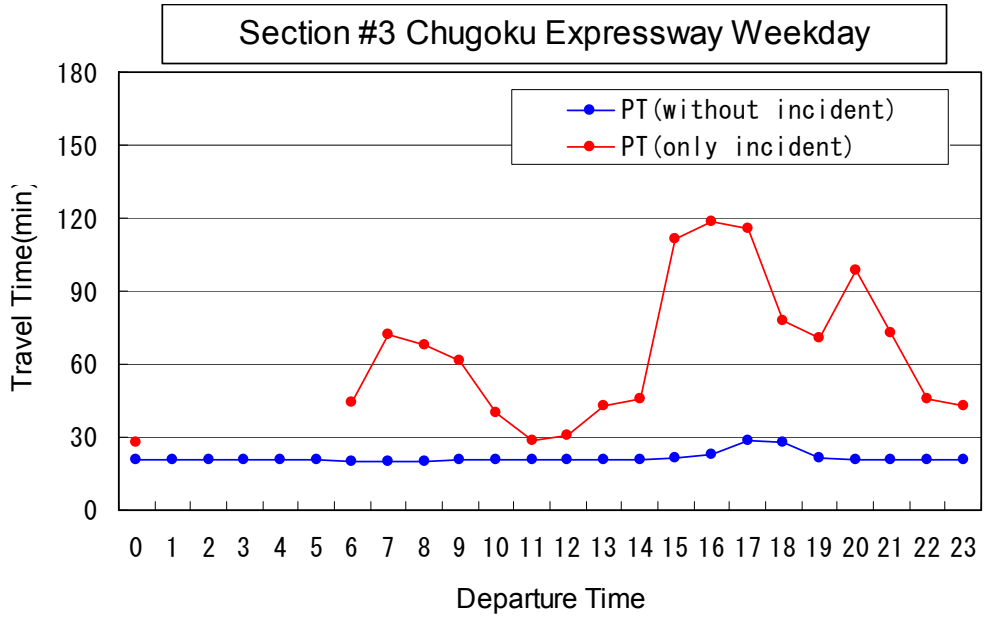
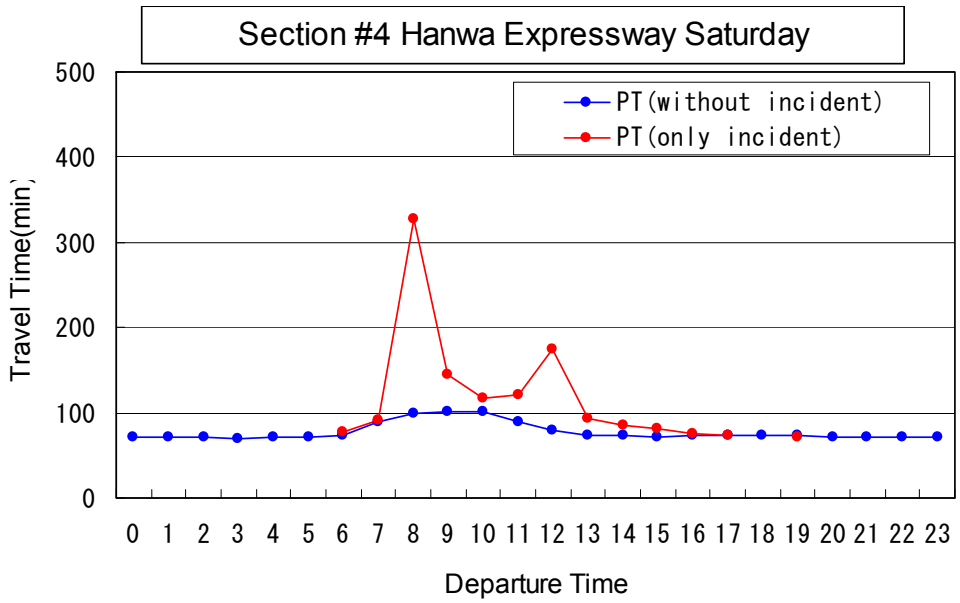


Fig. 11 Travel time (Period of Traffic congestion) without incident



PT with incident is larger than normal time each sections and each day. If many drivers are caught in a jam caused by incident, they are usually forced to spend more travel time than expected.
Especially, maximum value of *PT* with incident concerning the section No.4 (Hanwa Expwy from Matsubara to Gobo) is 327 minutes, drivers are forced unexpected travel time for 228 minutes in comparison with *PT* at normal time (99 minutes).
Maximum value of *PT* with incident is marked on various days, and the characteristic of day is almost negligible, the phenomenon may be caused anytime.
However, probability of encountering incident will be at most 10% in the section we analyzed, Whether the risk is acceptable or not depends on the drivers' perspective.

5. SUMMARY AND CONCLUSION

Currently, travel time reliability is not familiar with highway uses.
In order to establish a travel time estimation system like the time schedule of the railway, we must investigate users' acceptable range of the reliability. For example, we have to ask the truck drivers' perspective of the Buffer Time (95%-tile travel time or 80%-tile travel time or others) in order to minimize their risks.
At the same time, we must consider how we could advertise to the public and let them get these data easily. For example, we can recommend drivers the departure time at prearranged accommodation by working together with lodging reservation website.
In this study, the analysis was performed with the past 1 year data. We have to improve reliability by analyzing more data.